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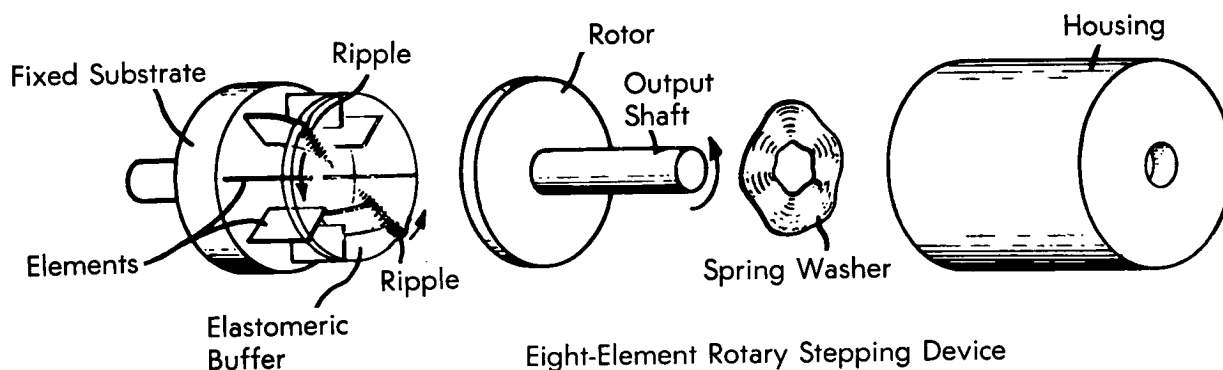
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Piezoelectric Actuator Uses Sequentially-Excited Multiple Elements — A Concept

The problem:

A nonmagnetic motor that has a long life and built-in redundancy is required for deployment or actuation of devices on spacecraft.

is embedded in the elastomeric buffer. When pulses are applied in the proper sequence to a series of elements mounted in an array such as is indicated in the diagram, the deflections of the piezoelectric



Eight-Element Rotary Stepping Device

The solution:

Utilize arrays of sequentially-excited piezoelectric elements to provide motion.

How it's done:

Motive force is supplied by a set of flat, shear-mode piezoelectric elements, with one end of each element rigidly fixed in an insulative substrate and the other end cemented to an elastomeric buffer as indicated in the diagram. Each element is electroplated on both sides; one side is connected to ground and the other to pulsing circuitry. The rotor is held in contact with the elastomeric buffer by a spring washer.

A voltage pulse applied to each piezoelectric element causes a small deflection of the free end which

elements appear as undulations in the elastomeric buffer which travel in a circular path.

In operation, a forward-pulse voltage, followed by a relatively lower reverse-pulse voltage, is applied to the first of a set of piezoelectric elements. At the same time that the reverse-voltage is supplied to the first set, another forward-pulse voltage is applied to the next set, etc., etc. Since the forward-pulse voltage is greater than the reverse-pulse voltage, the ripple generated in the elastomeric buffer by the forward pulse is larger than the one generated by the reverse pulse, and the rotor is thus urged forward by the larger ripple.

The proper sequence of voltage pulses may be provided by solid-state circuitry or by a bipolar capacitor-discharge excitation system which uses

(continued overleaf)

silicon-controlled rectifiers. Generally, the elements are switched sequentially from a positive voltage to a negative voltage; a monopolar pulse may be used, but a bipolar pulse is preferred because it minimizes damage from depolarization.

Notes:

1. Linear-motion motor devices can also be fabricated; in these instances, the piezoelectric elements are arranged in a linear array and the resulting ripple in the elastomeric buffer is made to travel in one direction. Ribbons, tapes, and films can be moved forward or backward with this arrangement.

2. Requests for further information may be directed to:

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Reference: TSP72-10096

Patent status:

No patent action is contemplated by NASA.

Source: Eric E. Sabelman of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11527)